

A Study of the Relationship of Solar Wind Streams with Geomagnetic Field Variation during Maximum Phase of Solar Cycle 23

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ABSTRACT

In the present analysis, events of high speed solar wind streams (HSSWS) have been taken to derive their relationship with geomagnetic activity for the period of 2000 to 2002, covering the phase of high solar activity period of solar cycle 23. Results of present analysis suggest that HSSW streams can produce increase in geomagnetic activity.

Keywords: Solar wind, solar cycle, geomagnetic field.

INTRODUCTION

It is well known that Sun and its outputs produce change in interplanetary space as well as near earth environment. One of the important sun related phenomena is known as solar wind. Solar wind is a coronal gas, which continuously blows outward radially with supersonic speed. The variability of solar wind velocity in the ecliptic plane has revealed a tendency for a high speed structure. Several solar scientists have studied the structure of HSSW streams giving various definitions of them (Iucci *et al.*, 1979; Mavromichalaki *et al.*, 1988)^{1,2}. Earlier, Desslear and Fejer³ (1963) proposed that geomagnetic activity would be influenced by irregularities in the solar wind and interplanetary magnetic field that are generated when a region of fast solar wind overtakes a region of slower solar wind. The

interaction between slow and fast solar wind produce shock waves and velocity discontinuity that is tangential to the interface separating the fast and slow streams. These discontinuity leads to interplanetary disturbances as well geomagnetic field variation. The IMF irregularities cause a time varying electric field, $E = -V \times B$, where V is the solar wind velocity and B is the interplanetary magnetic field. These electric field help to turn IMF B_z to southward along to the geomagnetic disturbance. A number of research work have been done time to time to show the relationship between solar wind and geomagnetic activity (Burlaga, 1979; Gavett *et al.*, 1979; Shrivastava and Shukla, 1993)⁴⁻⁶. In the present work, we have done statistical study to derive the relationship of solar wind velocity with geomagnetic Ap-index for the period of solar cycle 23.

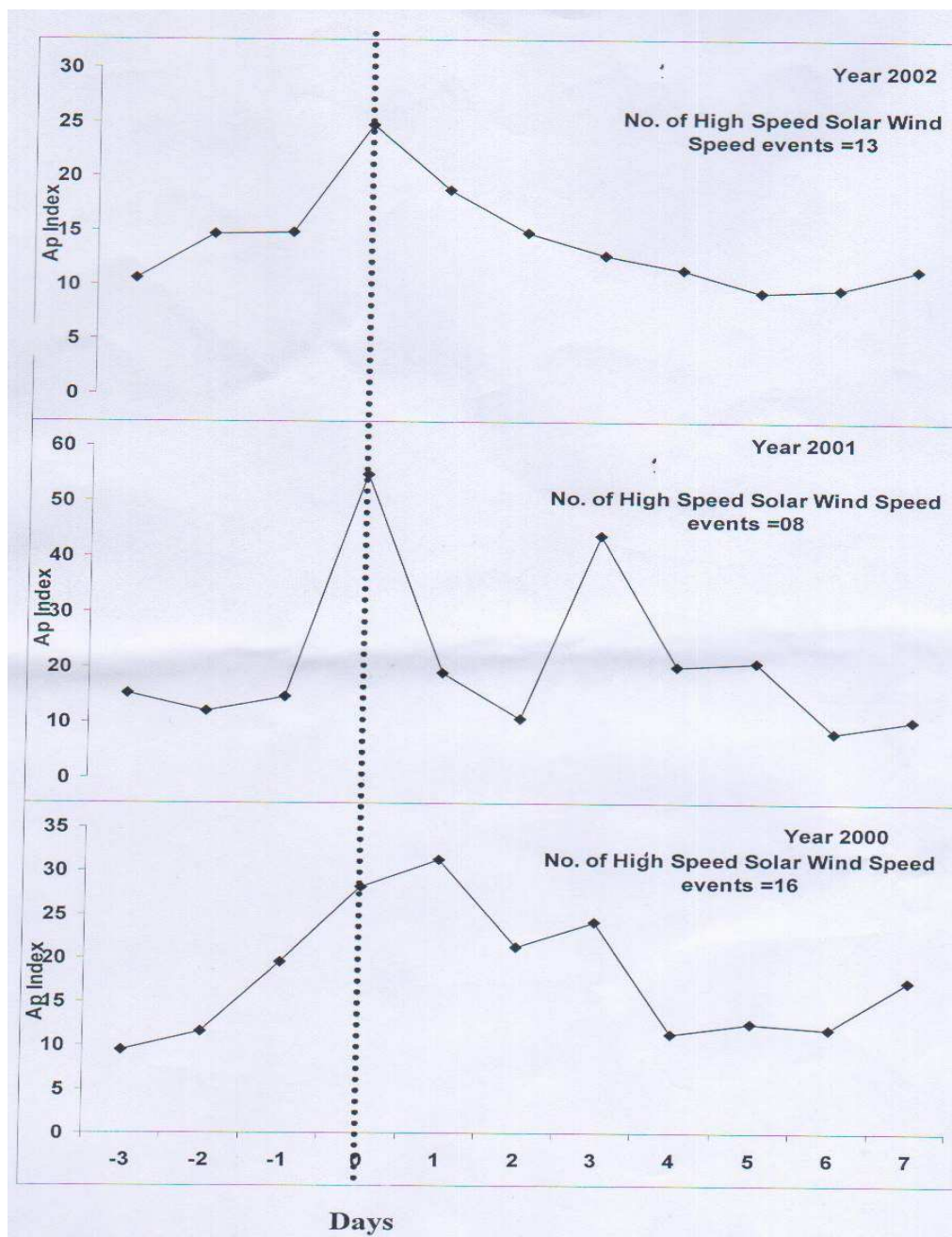


Figure 1- The result of Chree analysis for -3 to +7 days with respect to zero epoch days. The variation of Ap values is shown in figure. Zero epoch days correspond to the starting day of HSSW streams.

DATA AND METHOD OF ANALYSIS

We have sorted out the high speed solar wind streams (HSSWS) for the period of 1996 to 2007. Only those HSSWS have been taken which maximum velocity reaches to more than 450 km /s and remain more than three days. In this study, the method of Chree analysis of super epoch method has been adopted to derive the average behaviour of geomagnetic activity.

RESULTS AND DISCUSSION

The relationship between the solar activity and geomagnetic activity is a problem for investigation in solar terrestrial studies. It is believed that Sun propagate their energy to earth through interplanetary medium. In this paper an attempt has been made to examine the effect of high speed solar wind streams on geomagnetic activity for the period of mixed polarity years. To observe the average behaviour of geomagnetic disturbances during the period of HSSW streams, the Chree analysis as shown in fig.1 has been done for this study.

A large increase in A_p values on zero day (onset day of HSSW streams) is seen almost all the three years starting from 2000 to 2002. However we can notice double peak in A_p values for the year of 2001. The year 2001 is peculiar due to this period in the mid of mix polarity period, when the direction of magnetic field in

southern and northern hemisphere change their direction outward to inward and inward to outward. It is noted that the high speed solar wind streams produced enhancing in geomagnetic activity. A high geomagnetic field variation is initiated when enhanced energy transfer from the solar wind during the time of HSSW streams and interplanetary magnetic field (IMF) leads to intensification of earth ring current. Fenrich and Luhmann⁷ (2000) reported that the enhancement in geomagnetic activity level is also associated with solar wind dynamical pressure.

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